Comprehensive Overview of Biological Anthropology and Evolution (ANTH 10143)

Introduction to Biological Anthropology (University of Arkansas)

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Comprehensive Guide to Biological Anthropology and Evolutionary Biology

Definition of Biological Anthropology

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Subfields of Biological Anthropology

Biological anthropology encompasses several specialized areas:

- **Primatology:** The study of non-human primates, their behavior, evolution, and ecology.
- **Paleoanthropology:** The examination of fossil remains to understand human evolutionary history.
- **Bioarchaeology:** The analysis of human skeletal remains from archaeological sites to infer health, diet, and activity patterns.
- **Molecular Anthropology:** The study of genetic material to explore human variation, relationships, and evolution.
- **Forensic Anthropology:** Applying biological anthropology methods to identify human remains for legal purposes.
- **Human Biology:** Investigating contemporary human biological variation and how humans adapt biologically to different environments.

Genetic Similarity Among Humans

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Over **99.9%** of the human genome is shared among all modern humans, reflecting an extremely high level of genetic similarity. This indicates that genetic differences between individuals are minimal, yet these slight variations are responsible for the diversity in physical traits, health, and adaptations.

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Genetic evidence demonstrates that humans are most closely related to chimpanzees, sharing approximately **98–99%** of their DNA. The genetic similarity with gorillas is slightly less, highlighting our close evolutionary kinship within the great ape family and supporting the theory of common ancestry.

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participation, assessments, and understanding core concepts in biological anthropology.

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- The scientific method
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- Evolutionary biology
- Osteology and primatology
- Human evolution
- Contemporary topics such as human variation and adaptation

Definition of Anthropology

Anthropology is the **holistic study of humanity**—integrating biological, cultural, linguistic, and archaeological perspectives—to understand what makes us human across time and space.

Four Subfields of Anthropology

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3. **Biological Anthropology:** Study of human biological diversity, evolution, and adaptation.
4. **Linguistic Anthropology:** Study of language development, structure, and use in human groups.

Culture in Anthropology

Culture is learned behavior transmitted across generations, encompassing beliefs, practices, arts, and social norms. Cultural

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anthropologists examine contemporary societies to understand how culture shapes human behavior and identity.

Biological Anthropology Definition

Biological anthropology investigates human biological variation, evolution, and adaptation, seeking to understand the biological basis of human diversity and our evolutionary history.

Biocultural Approach

This approach emphasizes the **interrelationship between biology and culture**, recognizing that biological traits are influenced by cultural practices and environmental factors, and vice versa.

Biological Anthropology's Allied Fields

Biological anthropology draws from:

- **Archaeology:** Contextualizes biological findings within cultural history.
- **Ecology:** Studies environmental influences on human biology.
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The scientific method involves:

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4. Analyzing results.
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A **scientific theory** is a well-supported, comprehensive explanation of phenomena, based on extensive testing and evidence. It is **not just a guess** but a robust framework, e.g., the **Theory of Evolution**.

Theory of Evolution

Evolution explains how species **change over time** via mechanisms like **natural selection**, **mutation**, **genetic drift**, and **gene flow**. It is supported by:

- The **fossil record**
- **Genetic data**
- **Comparative anatomy**

Scientific Laws

Laws describe **what happens** under specific conditions, often expressed mathematically, e.g., **Newton's Law of Gravity**: every mass attracts every

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other mass, with force proportional to mass and inversely proportional to the square of distance.

Difference Between Theory and Law

- **Law:** Describes **what** occurs (e.g., gravity).
- **Theory:** Explains **why** and **how** phenomena occur (e.g., evolution by natural selection).

Science as a Self-correcting Process

Scientific claims are **provisional**; as new evidence emerges, theories are refined or rejected, exemplifying science's **iterative and self-correcting** nature.

Peer Review in Science

Before publication, research undergoes **peer review**, where experts evaluate methods, data, and conclusions, ensuring **quality, credibility**, and **scientific integrity**.

Historical Perspectives on Evolution

- **Ancient & Indigenous Ideas:** Early humans observed nature, developing ideas about change and adaptation, as seen in archaeological sites like Cañadón del Río Pinturas.
- **Classical & Medieval Thought:** Philosophers like Aristotle and medieval scholars laid philosophical foundations, often blending religious beliefs with natural history.
- **Islamic & Asian Contributions:** Scholars from the Islamic Golden Age and Asia made early advances in natural philosophy, influencing later scientific ideas about species and change.

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The Enlightenment and Pre-Darwinian Science

The 1700s Enlightenment fostered critical scientific inquiry, questioning traditional views and proposing hypotheses about natural change, setting the stage for Darwin's revolutionary ideas.

Evolutionary Thought Before Darwin

Prior to Darwin, ideas about species change were influenced by:

- Enlightenment thinkers
- Ancient philosophies
- Indigenous knowledge
- Theological interpretations (e.g., fixity of species)

Darwin’s Early Life and Voyage

Born in 1809, Darwin’s voyage on the **HMS Beagle** provided crucial observations of natural variation and adaptation, leading to his formulation of natural selection.

Origin of Species and Critiques

Darwin’s **"On the Origin of Species"** (1859) introduced natural selection but faced scientific and religious critiques, sparking ongoing debates about the mechanisms of evolution.

Mendel and Genetics

Gregor Mendel’s experiments with pea plants established **laws of inheritance**—segregation, independent assortment, and dominance—that underpin modern genetics and explain how traits are transmitted.

Molecular Biology and Cell Types

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- **DNA:** The hereditary molecule composed of four bases (A, T, C, G), following specific pairing rules (A-T, C-G).
- **Cells:** Organized into **prokaryotic** (simple, no nucleus) and **eukaryotic** (complex, with nucleus) types.
- **Organelles:** Structures like the nucleus, mitochondria, Golgi apparatus perform specialized functions within eukaryotic cells.

Cell Division

- **Mitosis:** Produces identical somatic cells for growth and repair.
- **Meiosis:** Produces gametes (sperm and eggs) with half the chromosome number, introducing genetic variation through crossing over and independent assortment.

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The process of translating genetic code into proteins involves:

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- Translation: mRNA → amino acid chain (protein) via ribosomes and tRNA.

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Mutations are changes in DNA sequences:

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Genetic Variation and Population Genetics

- **Alleles:** Variants of a gene.
- **Gene pool:** All alleles in a population.

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- **Allele frequencies:** Proportion of each allele, changing over time through evolutionary mechanisms.

Evolution as Change in Gene Frequencies

Evolution occurs when allele frequencies shift due to:

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Human Biological Variation and Adaptation

- **Clinal variation:** Gradual change in traits across geography.
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